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Dated 12 November 2001

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1.	Your reference	SJA/57556/000
2.	Patent application number *(The Patent Office will fill in this part)*	**0113897.3**
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	**Alpha Fry Limited** **Tandem House** **Marlowe Way** **Croydon** **CRO 4XS** **United Kingdom**
	Patents ADP number *(if you know it)*	07336400C2
	If the applicant is a corporate body, give the country/state of its incorporation	**United Kingdom**
4.	Title of the invention	**SOLDERING FLUX VEHICLE ADDITIVE**
5.	Name of your agent *(if you have one)*	**BOULT WADE TENNANT**
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	**VERULAM GARDENS** **70 GRAY'S INN ROAD** **LONDON WC1X 8BT**
	Patents ADP number *(if you know it)*	**42001** ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number (if you know it)	Date of filing *(day/month/year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? **YES**

(Answer 'Yes' if:
a) any applicant named in part 3 is not an inventor, or
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Continuation sheets of this form	
Description	7
Claim(s)	2
Abstract	
Drawing(s)	1

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(Please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature: Burk Wade Tennant

Date: 7 June 2001

12. Name and daytime telephone number of person to contact in the United Kingdom: **Susan J. Allard**
020 7430 7500

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SOLDERING FLUX VEHICLE ADDITIVE

The present invention relates to a soldering flux vehicle which contains an additive to enhance fine pitch stencil printing, and to solder pastes for use in the electronics industry which are prepared using this flux vehicle.

There is a trend in the electronics industry towards the automated manufacture of printed circuit boards (PCBs) and towards the miniaturization of electronic devices with the requirement of finer and finer pitch devices. Solder paste is generally printed onto a substrate through a stainless steel or electroformed stencil. Industry standard stencils for PCB manufacture are generally 0.125mm or 0.150mm in thickness and solder pastes comprising solder powder particles of 25 to 45 microns in diameter are required to print 0.25mm diameter apertures at a 0.5mm pitch.

Solder paste release from a stainless steel or electroformed stencil and subsequent printed pad definition on a PCB is influenced by the chemical nature of the solder paste and, in particular, the soldering flux vehicle. A solder paste has to have a certain amount of "tack" in order that components can be placed in position on the printed solder paste pads accurately and without loss. However, the tackiness of the solder paste which holds a component in position often prevents good printing of the solder paste onto a substrate through a stencil, i.e. good aperture release of the solder paste on printing may be prevented.

Accordingly, there is a requirement for an improved solder flux vehicle and solder paste formulation which has an improved release from a stencil during printing, whilst maintaining the internal tackiness of the solder paste thereby preventing loss of components during the assembly

placement of the components onto the PCB.

Accordingly, the present invention provides a solder paste formulation which comprises a solder paste powder and a non-aqueous vehicle, characterized in that the vehicle includes therein at least one lubricant additive which is a branched chain fatty alcohol or fatty acid containing a total of from 8 to 50 carbon atoms with a minimum of 4 carbon atoms being present in the shorter alkyl chain, or an ester thereof.

Particularly preferred lubricant additives for use in the present invention are those comprising a branched chain fatty alcohol or fatty acid, or an ester thereof, wherein the branch point is at the second carbon position. These compounds are generally known as Guerbet alcohols or Guerbet acids.

Specific examples of Guerbet alcohols and Guerbet acids for use in the present invention are 2-butyl-1-octanol, 2-butyl-1-decanol, 2-hexyl-1-octanol, 2-hexyl-1-decanol, 2-hexyl-1-dodecanol, 2-octyl-1-dodecanol, 2-decyl-1-tetradecanol, 2-butyloctanoic acid, 2-butyldecanoic acid, 2-hexyldecanoic acid, 2-hexyldodecanoic acid, 2-octyldodecanoic acid, 2-decyltetradecanoic acid or 2-hexadecyleicosanoic acid.

The lubricant additive may be an ester of a fatty alcohol as defined above with a fatty acid, dibasic acid or tribasic acid. Examples are the stearates, oleates, palmitates, isostearates, adipates, trimellitates, thiodipropionates or pentaerythritol esters.

The solder paste compositions of the present invention will generally comprise from 75% to 95% by weight of solder powder, preferably 85% to 90% by weight of solder powder. The solder powder will generally have an average particle size in the range of from 10 to 80 micrometres, preferably 25 to 45 micrometres.

The solder paste is formed from a suitable alloy composition, for example an SnPb (such as Sn37Pb63), SnPbBi, SnBi, SnPbAg; SnAgCu, SnAgCuBi, SnZnBi.

The vehicle which is used in the compositions of the present invention will generally comprise at least one polar organic solvent such as a polyhydric alcohol including ethylene glycol, diethylene glycol, propylene glycol, sorbitol, pentaerythritol and derivatives thereof, butyl diglyme, dibutyl itaconate, di(propylene glycol) butyl ether, 2-ethyl hexyl diglycol, γ-butyrolactone, hexyl carbitol, N-methyl pyrrolidone, N-ethyl pyrrolidone, terpineol or tetraglyme. Tri(propylene glycol) butyl ether is particularly preferred.

The vehicle will generally contain one or more thickeners which enable the rheological characteristics of the vehicle to be modified, as required. Suitable thickeners include polyacrylic acid, hydrogenated castor oil and derivatives thereof, polyamides or resins which may be included in an amount of up to 30wt%.

It may be also be necessary for further components to be added to the vehicle to provide, for instance, fluxing activity for solder reflow. Typical fluxing additives which are known to those skilled in the art may be used. Activators may be included in the solder paste compositions in an amount of up to 7wt%. Other additives may include tackifier(s) and/or antioxidants and/or surfactants at a level of less than 5wt%.

The solder pastes of the present invention contain from 0.1 to 2% by weight of the lubricant additive.

The solder pastes of the present invention possess the advantage that they have an improved release from a stencil during printing and thus are adapted for use in fine pitch stencil printing.

The following non-limiting Examples illustrate the present invention.

EXAMPLES 1 TO 10

A number of flux gels were produced from the following components given in Table 1 and then mixed with solder powder (Sn62Pb36Ag2 of 25 to 45 micrometres diameter) to give a solder paste containing 10% flux gel and 90% solder powder.

TABLE 1

Ex. No. / Components	Comp.	1	2	3	4	5	6	7	8	9	10
	%	%	%	%	%	%	%	%	%	%	%
Rosin (KE604)	40	35	35	35	35	35	35	35	35	35	35
TPNB	54	54	54	54	54	54	54	58	39	58	39
Styrene dibromide	2	2	2	2	2	2	2	2	2	2	2
Thixatrol +	4	4	4	4	4	4	4	4	4	4	4
Isocarb 24		5				2.5	4	1	20		
Isocarb 36			5								
Isocarb ester 1605				5		2.5	1			1	20
Isofol 24					5						

Footnotes to the Table

Rosin(KE604)	Arakawa	Acid modified hydrogenated rosin
TPNB	DOW	Tri(Propylene Glycol) Butyl Ether
Thixatrol +	Rheox	Rheological additive
Isocarb 24	Condea	2-decyltetradecanoic acid
Isocarb 36	Condea	2-hexadecyleicosanoic acid
Isocarb ester 1605	Condea	2-hexyldecanoic acid-pentaerythritol ester
Isofol 24	Condea	2-decyltetradecanol

The solder pastes were each printed through a series of 250 micrometre apertures using an electroformed stencil 0.125mm thick and an MPM AP27 printer.

The 1st, 5th and 10th prints were visually examined and compared with a visual standard. In addition the appearance of the first print was recorded at 90 and 45 degrees using the SPIDA (Solder Paste Inspection Data Analyser).

The visual standard which was used to assess the print definition on inspection is described with reference to Figure 1. Referring to Figure 1, T represents the stencil thickness, A the aperture diameter, D the paste diameter and H the paste height. The following scores were given.

SCORE	DESCRIPTION	VALUES
1	No paste or almost no paste	D<1/2A H<1/3T
2	More than ½ of pad area covered but insufficient height	D>1/2A H<2/3T
3	More than ⅔ pad area covered, paste reaches same height	D>2/3A H=T for <1/3A
4	More than ⅔ pad area covered and diameter of top is > ⅓ of aperture	D>2/3A H=T for <1/2A
5	Perfect deposit, same shape as stencil aperture	D = A H = T for > 2/3A

Results

The results of the visual inspections are given in Table 2 below.

TABLE 2

Example	**Additive (%)**	**Score**
Comparative	None	2
1	Isocarb 24	3
2	Isocarb 36	5
3	Isocarb ester 1605	4
4	Isofol 24	4
5	Isocarb 24 (2.5)/Isocarb ester 1605 (2.5)	4
6	Isocarb 24 (4)/Isocarb ester 1605 (1)	3
7	Isocarb 24 (1)	3
8	Isocarb 24 (20)	4
9	Isocarb ester 1605 (1)	3
10	Isocarb ester 1605 (20)	3

It can be seen from the results given in Table 2 that the solder pastes made with flux gels containing the lubricant additions showed improved print definition when compared with a paste made with a flux gel containing no lubricant addition.

CLAIMS:

1. A solder paste formulation which comprises a solder paste powder and a non-aqueous vehicle, characterized in that the vehicle includes therein at least one lubricant additive which is a branched chain fatty alcohol or fatty acid containing a total of from 8 to 50 carbon atoms with a minimum of 4 carbon atoms being present in the shorter alkyl chain, or an ester thereof.

2. A solder paste formulation as claimed in claim 1 wherein the additive is a branched chain fatty alcohol or fatty acid wherein the branch point is at the second carbon position.

3. A solder paste formulation as claimed in claim 1 or claim 2 wherein the additive is 2-butyl-1-octanol, 2-butyl-1-decanol, 2-hexyl-1-octanol, 2-hexyl-1-decanol, 2-hexyl-1-dodecanol, 2-octyl-1-dodecanol, 2-decyl-1-tetradecanol, 2-butyloctanoic acid, 2-butyldecanoic acid, 2-hexyldecanoic acid, 2-hexyldodecanoic acid, 2-octyldodecanoic acid, 2-decyltetradecanoic acid or 2-hexadecyleicosanoic acid.

4. A solder paste formulation as claimed in claim 1 or claim 2 wherein the additive is an ester of a fatty alcohol as defined with a fatty acid, dibasic acid or tribasic acid.

5. A solder paste formulation as claimed in claim 4 wherein the ester is a stearate, oleate, palmitate, isostearate, adipate, trimellitate, thiodipropionate or pentaerythritol ester.

6. A solder paste formulation as claimed in any

one of the preceding claims which comprises from 75% to 95% by weight of a solder powder.

7. A solder paste formulation as claimed in claim 6 wherein the solder powder is an alloy composition of SnPb, SnPbBi, SnBi, SnPbAg, SnAgCu, SnAgCuBi or SnZnBi.

8. A solder paste composition as claimed in any one of the preceding claims wherein the solder powder has an average particle size in the range of from 10 to 80 micrometres.

9. A solder paste composition as claimed in claim 8 wherein the solder powder has an average particle size in the range of from 25 to 45 micrometres.

10. A solder paste composition as claimed in any one of the preceding claims which comprises from 0.1 to 2% by weight of the lubricant additive.

FIG. 1.